

Supporting English Language Learners in the STEM Disciplines



2016 OELAS Conference

Goals

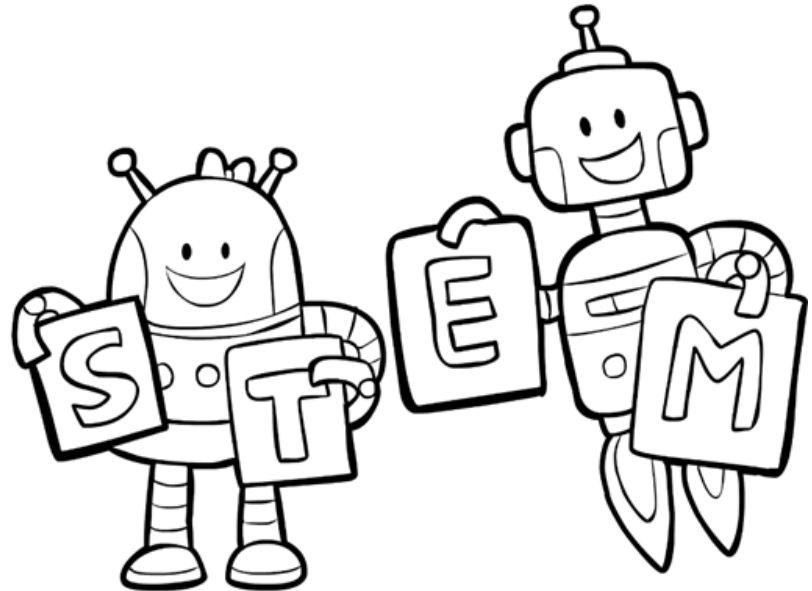
Participants will:

- Integrate the STEM disciplines in an effective and meaningful manner to improve both academic language and content area knowledge of English Language Learners.
- Investigate research-based resources and strategies to develop integrated STEM teaching and learning opportunities for English Language Learners.

What is STEM?

Write down your personal definition of STEM teaching and learning.

Be ready to share one or two sentences/phrases with your group.



Why STEM?

According to a report from the National Academy of Sciences, the fields of science, technology, and education hold a paramount place in the modern world...

but there are not enough qualified workers in the US entering the STEM professions.



From Silos...



Science Instruction

- to use scientific knowledge and processes



Technology Instruction

- to shape and change the physical world to meet needs



Engineering Instruction

- to engage in a systematic practice of design to achieve solutions to particular human problems



Mathematics Instruction

- to analyze, reason, and communicate ideas effectively as they pose, formulate, solve, and interpret solutions to mathematical problems

...to Integration



STEM education is an integrated, interdisciplinary approach to learning that provides hands-on and relevant learning experiences for students.

STEM learning engages students and equips them with critical thinking, problem solving, creative and collaborative skills, and ultimately establishes connections between the school, work place, community and the global economy.

STEM instruction helps students in developing conceptual understanding in science and mathematical concepts, technical and engineering practices, and disciplinary discourse.

Goals in STEM Education for Students

- STEM literacy
- 21st century competencies
- STEM workforce readiness
- Interest and engagement
- Ability to make the connections among STEM disciplines and Arizona academic standards



ILLP or SEI?

Mainstream Classroom - ILLP

- ELP Standards to differentiate instruction

SEI Classroom

- ELP Standards drive instruction
- Use science content within the time allocations

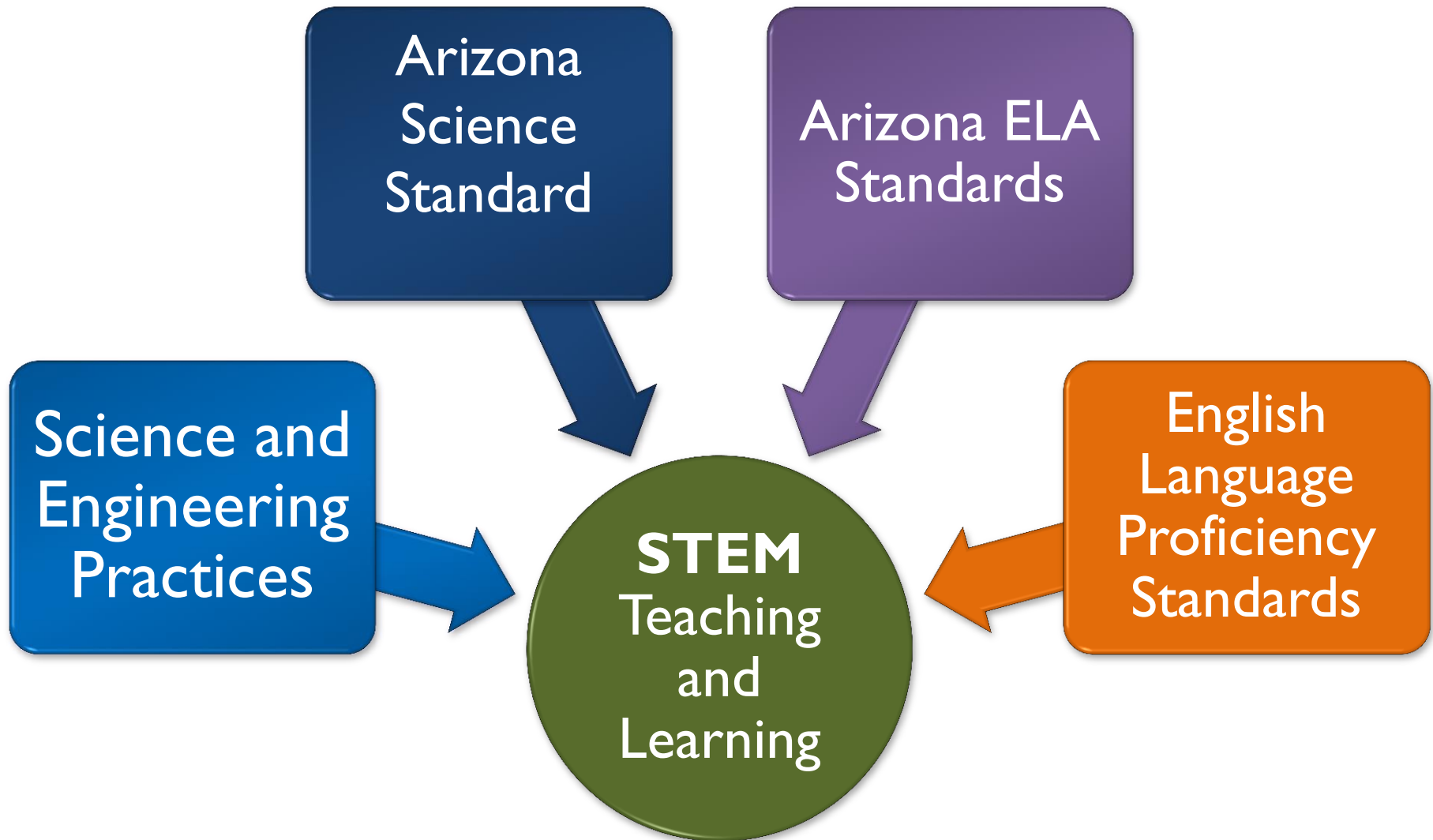
**Arizona
Science
Standard**

**A Framework for K-12
Science Education
Science and Engineering
Practices**

**Arizona ELA
Standards**

**English Language
Proficiency
Standards**

Standards Connections



Engagement for ALL Students

Practices in Mathematics, Science & Engineering, and Literacy		
Math	Science & Engineering	Literacy
M1. Make sense of problems and persevere in solving them. M2. Reason abstractly and quantitatively. M3. Construct viable arguments and critique the reasoning of others. M4. Model with mathematics. M5. Use appropriate tools strategically. M6. Attend to precision. M7. Look for and make use of structure. M8. Look for and express regularity in repeated reasoning.	S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics, information and computer technology, and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information.	L1. Demonstrate independence in reading complex texts, and writing and speaking about them. L2. Build a strong base of knowledge through content rich texts. L3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose. L4. Construct viable arguments and critique reasoning of others. L5. Read, write, and speak grounded in evidence. L6. Use technology and digital media strategically and capably. L7. Come to understand other perspectives and cultures through reading, listening, and collaborations.

The 5Es

EVALUATION

- Students assess their knowledge, skills and abilities.
- Activities permit evaluation of student development and lesson effectiveness.

- Students explain their understanding of concepts and processes.
- New concepts and skills are introduced as conceptual clarity and cohesion are sought.

ELABORATION

- Activities allow students to apply concepts in contexts, and build on or extend understanding and skill.

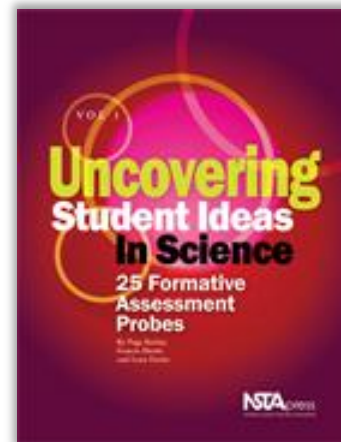
EVALUATION

- Students assess their knowledge, skills and abilities.
- Activities permit evaluation of student development and lesson effectiveness.



Engage

- Intended to capture students' attention, get them thinking, raise questions, access prior knowledge

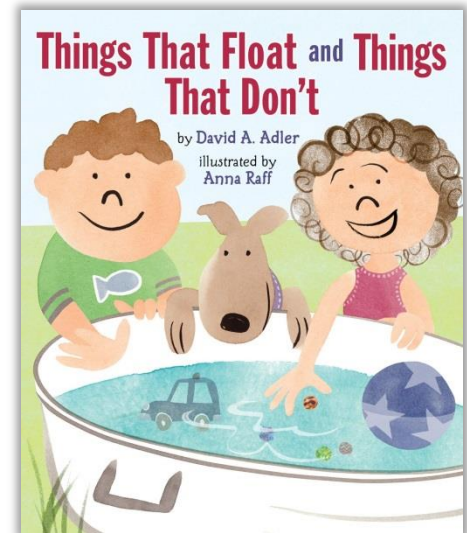
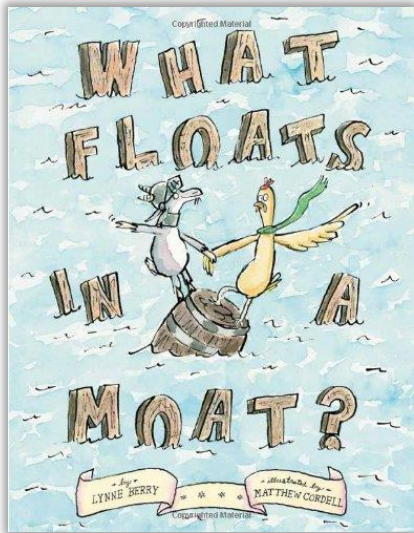


Page Keeley
<http://uncoveringstudentideas.org/>



Engage

In the texts, the big idea of floating and sinking is investigated throughout the stories to help students understand that different properties are suited to different purposes.



Engage

Listening and Speaking

II-LS-1:HI-2: summarizing main

ete sentences..



II-LS-I:HI-7: responding to academic discussions by sharing one's view on facts, ideas, and/or events using academic vocabulary.

“Will a piece of aluminum foil that is crushed into a loose ball sink or float?
What if it was made into a very tight ball?”



Engage

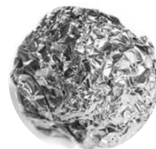
Listening and Speaking



II-LS-1:HI-7: responding to academic discussions by sharing one's view on facts, ideas, and/or events using academic vocabulary.

II-LS-2:HI-5: asking and responding to academic questions using complete sentences.

- Response stems
 - I think _____ because...
 - I think _____ will _____ because...
- Visual scaffold
 - Sort and use key words



Tiered Vocabulary



Tier 1

- Most basic words
- Rarely require instruction in school

- shape

Tier 2

- Words that are of high frequency for mature language users and are found across a variety of domains
- Instruction adds productivity to an individual's ability

- sink
- float
- displace
- matter

Tier 3

- Words whose frequency of use is quite low and is often limited to specific domains
- Best learned when needed in a content area

- buoyancy
- density
- Properties of Matter

Explore

- The opportunity for students to observe, test ideas, record data, return to their original questions.



Explore

Listening and Speaking



II-LS-1:HI-7: responding to academic discussions by sharing one's view on facts, ideas, and/or events using academic vocabulary.

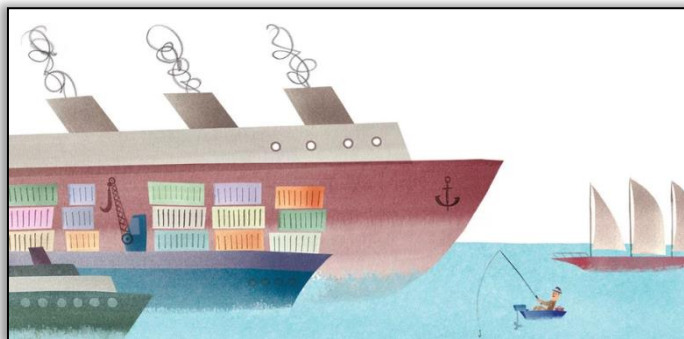
II-LS-2:HI-5: asking and responding to academic questions using complete sentences.

Will it sink or will it float? Explain your reasoning.

How about a half-stick of clay?

What happens when you change the shape? Form it into the shape of a boat.

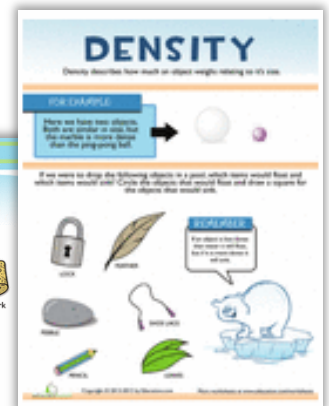
What happens when you add marbles to the boat?



Do you think too many marbles could sink the boat?

Explain

- Students demonstrate their conceptual understanding, process skills, or behaviors – learners need opportunities to explain their understanding of the concept.
- Formally provide definitions, explanations and new labels. With older students it would also include introducing of models, laws, theories.



Explain

Discussion to Writing

My boat design.	My boat in the water.
Prediction:	Actual:



Explain

Writing



II-W-5:HI-2: gathering information to answer questions about a topic or event for a report.





Discussion to Writing

<p>My boat design (sketch and description)</p>	<p>When I put my boat in the water, it looked like this...</p> 
<p>If I add pennies to my boat, I predict that...</p> <p>I predict that I'll add _____ pennies.</p>	<p>After adding marbles to my boat, it looked like this...</p>  <p>My boat held _____ pennies.</p>

Elaborate

- Students engage in discussions and information seeking activities. Students apply their understanding of the concept by conducting additional activities.



Day	Phase	Moonrise	Moonset
1	 New Moon	Rises around sunrise. Is in the sky all day long, although it is hard to see.	Sets around sunset. Is not seen in the night sky.
7	 First Quarter Moon	Rises around noon.	Sets around midnight.
14	 Full Moon	Rises around sunset. Is seen all night.	Sets around sunrise
21	 Last Quarter Moon	Rises around midnight.	Sets at noon.

Elaborate

The Problem:

How would you design a boat that can float holding the most pennies?



Elaborate

Listening & Speaking



II-LS-I:HI-6: following multiple-step directions which include prepositions.

II-LS-I:HI-7: responding to academic discussions by sharing one's view on facts, ideas, and/or events using academic vocabulary.



The Problem:

How would you design a boat that can float holding the most pennies?

Discussion Stems:

- I predict that...
- I noticed...
- I agree with ____ because...
- I disagree with ____ because...
- What if we ____?
- What would happen if ____?
- Could you give me an example?
- Could you tell me more about ____?

Constraints

What are some things you must take into consideration while designing your boat?

- You have 15 minutes to complete the task.
- You must use the supplies provided.
- You must design a boat using aluminum foil that will hold the most pennies without sinking or taking on water.
- You will need to provide support and evidence for your design.

What problem are you trying to solve?

What does success look like?

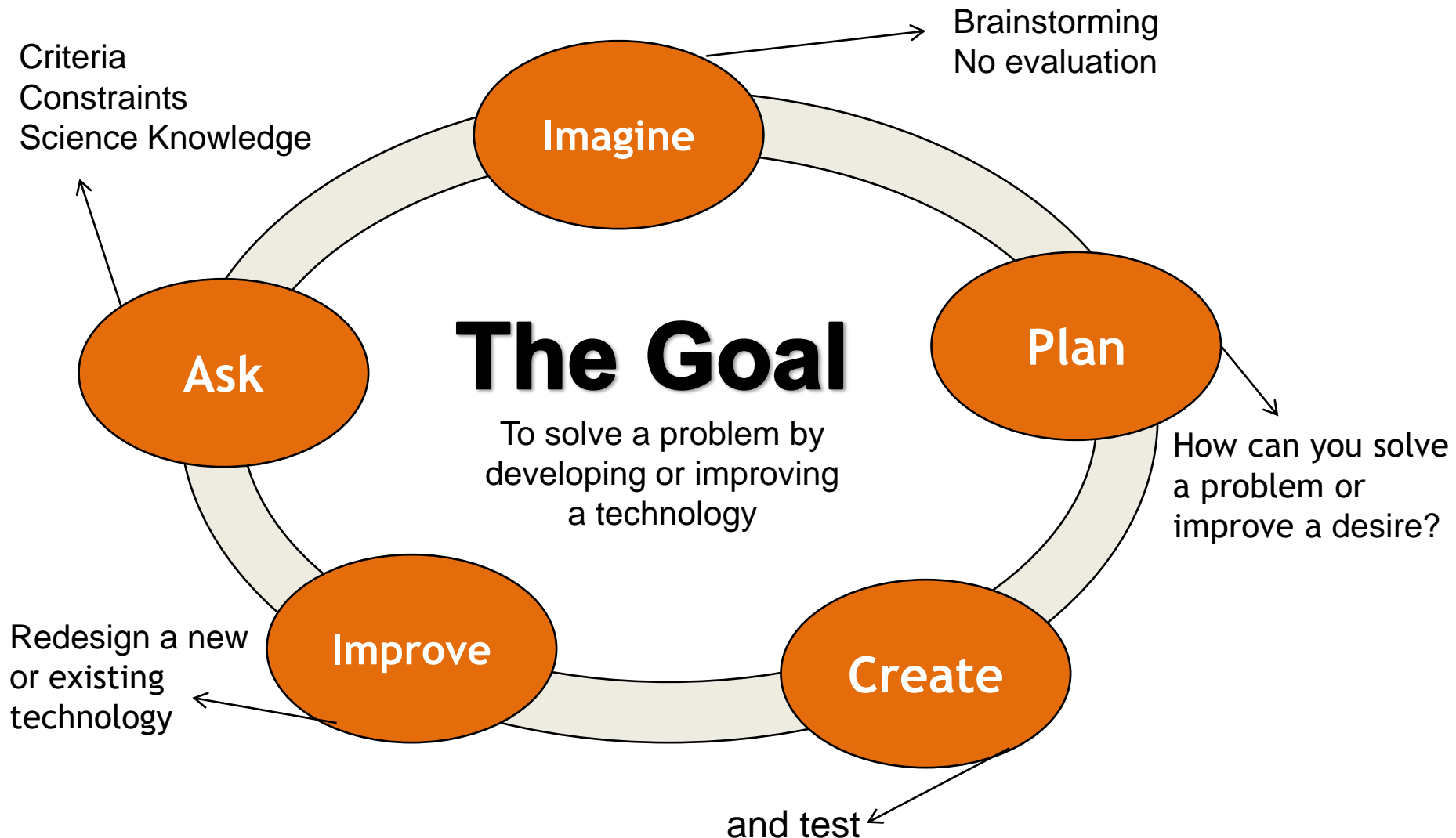
- How will you know if you have accomplished the task?



- What should the final product should look like or be able to do?
- Collect data, record findings, and track your work.

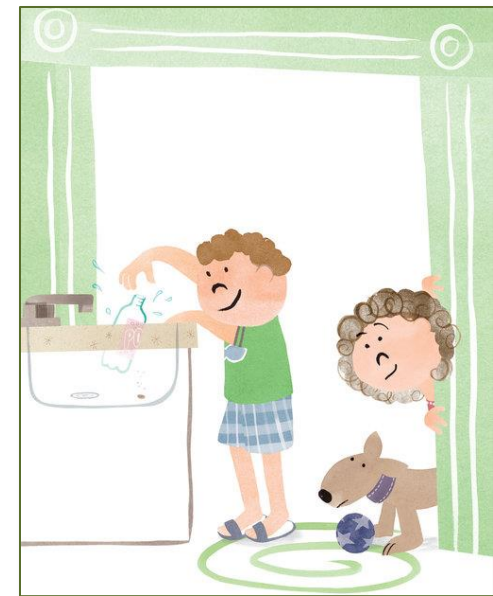
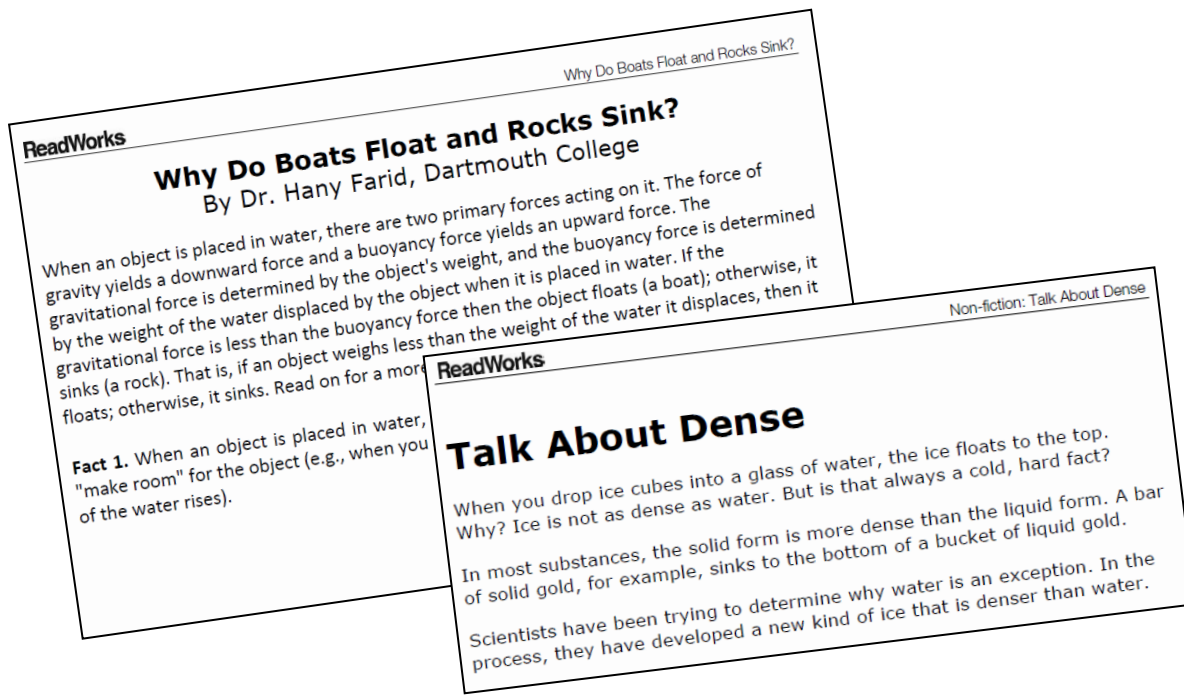
Gather, Reason, Communicate

Engineering Design Process



Building Connections

- Additional reading to support the challenge
- Connections to real-life and current day



Building Connections

Reading

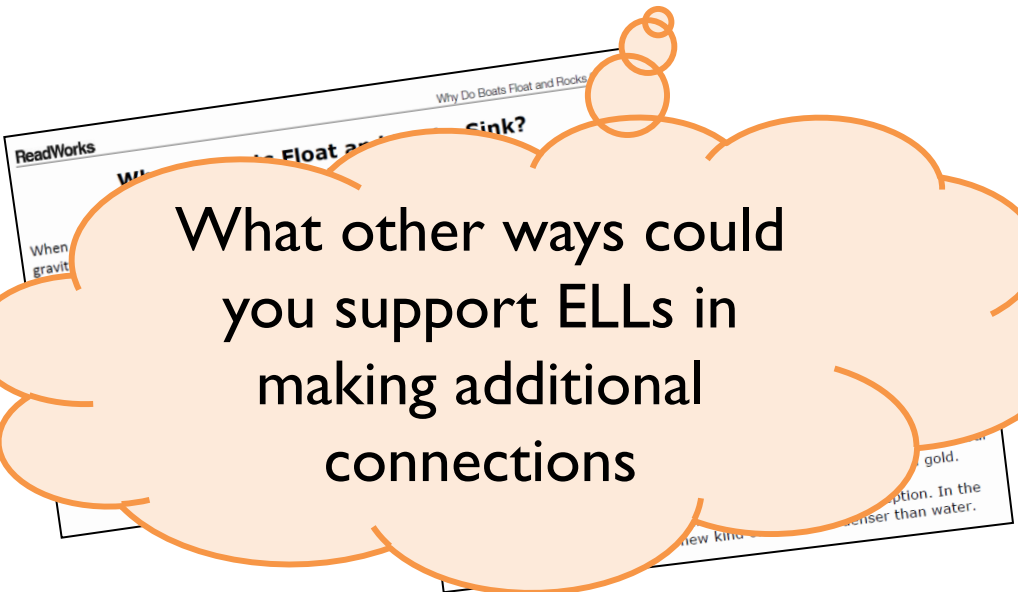


II-R-4:HI-3: locating facts and answering questions about text.

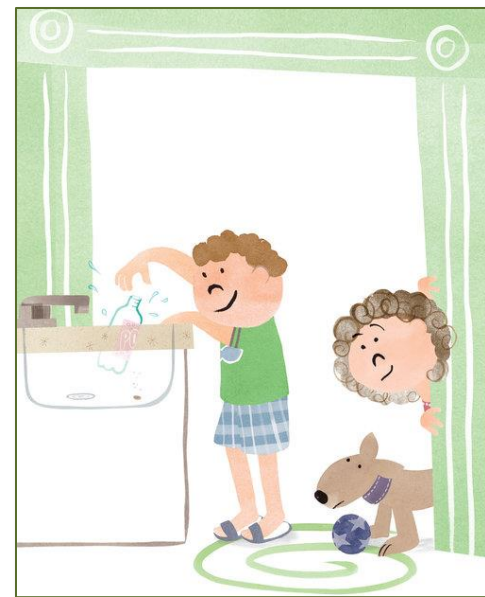
II-R-4:HI-5: sequencing a story or event with a beginning, middle and end with transition words/ phrases in complete sentences.

II-R-4:HI-6: making connections to text while reading.

- Pre-read text to be completed as a class
- Related text

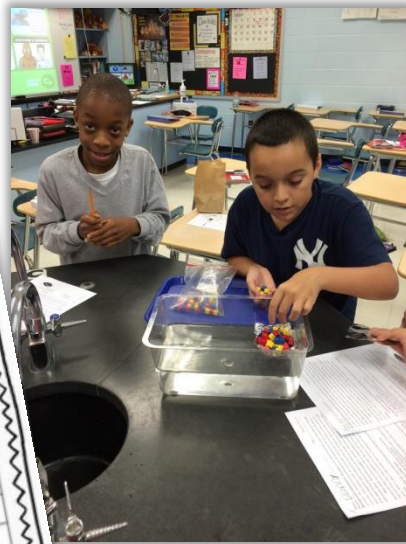


What other ways could you support ELLs in making additional connections



Evaluate

- Students use the skills they have acquired to evaluate their understanding and receive feedback on their explanations.



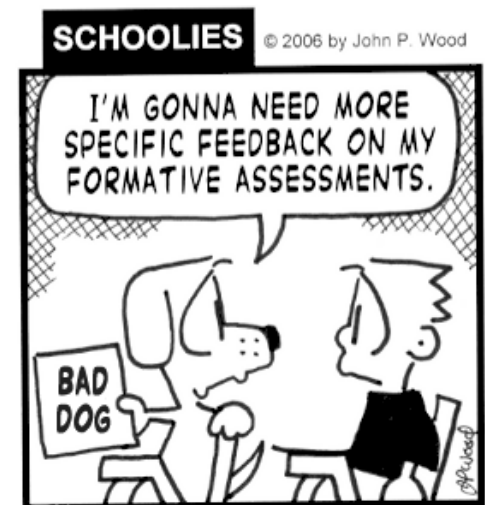
Evaluate

- Includes both formative and summative evaluations of student learning.
- Engaging students in the Practices allows for authentic opportunities to assess.

Rubric

	3	2	1
Focus on Assignment	Stays on task during assignment. Needs 0 reminders to stay on task.	Needs 1-2 reminders to stay on task.	Needs 3 or more reminders to stay on task during challenge.
Use of plan, create, improve model	Uses the PD model using the recording sheet. If the tool asks, the student revises the plan appropriately with the or no prompting.	Requires slight assistance in creating a PD plan.	Student needs heavy support creating the PD plan.
Explanation of model	Student is able to explain why her she used specific materials. Given 3 or more examples.	Student explains 1-2 items in their boat and requires prompting to explain why those items were used.	Student is unable to explain why her she used certain materials to build their boat.

Science score: **99**



Evaluate

Writing



II-W-1:HI-3: completing a written summary of the key events or ideas of informational text using simple sentences.

II-W-5:HI-1: formulating and writing questions about a topic or event in order to gather research for a report.

II-W-5:HI-3: writing a three paragraph report including a title and three facts based on collected data about objects, people or events.

	3	2	1
Focus on Assignment	Stays on task during assignment Needs 0 reminders to stay on task	Needs 1-2 reminders to stay on task	Needs 3 or more reminders to stay on task during challenge
Use of plan, create, improve model	Uses the PC model using the recording sheet. If the boat sinks, the student revises the plan appropriately with little or no prompting	Requires slight assistance in creating a PC plan	Student needs heavy support creating the PC plan
Explanation of model	Student is able to explain why/when she used specific materials. Given 3 or more examples	Student explains 1-2 items in their boat and requires prompting to explain why those items were used	Student is unable to explain why/when she used certain materials to build their boat

Science score y9

Evaluate

Self-Reflection

- One thing I learned: ____
- Something new I learned about ____ is ...
- I contributed to the group's design by...
- I shared my ideas by...
- I listened to my group member's ideas by...
- In my next group challenge, I will ...

Group-Reflection

- Something my group did well: ____
- Something my group can improve on for the next challenge: ____



Evaluate

- How did you design a boat that can float holding the most pennies?
- What did you have to consider in designing a boat that can float holding the most pennies possible?

Think Your ideas go here.	Pair Listen to and record your partner's ideas here.
Share Talk with your partner to come to some common understanding and write our joint ideas here.	

Evaluate

Writing



- II-W-1:HI-3:** completing a written summary of the key events or ideas of informational text using simple sentences.
- II-W-5:HI-1:** formulating and writing questions about a topic or event in order to gather research for a report.

- How did you design a boat that can float?
- What did you have to think about when you built your boat?

Think

Your ideas go here.

Pair

Listen to and record your partner's ideas here.

Share

Talk with your partner to come to some common understanding and write our joint ideas here.

What could you do to scaffold this task for the ELLs in your class?

Evaluate

Question:

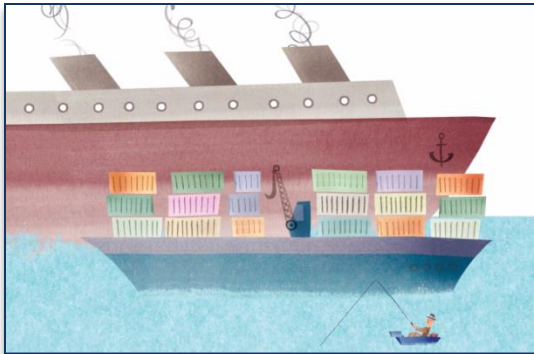
Claim:

Evidence:

Evidence:

Evidence:

Reasoning:



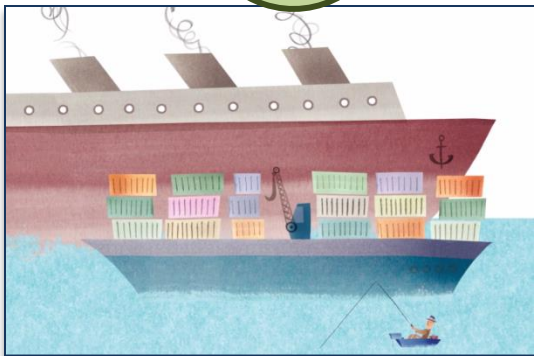
Evaluate

Writing



II-W-5:HI-3: writing a three paragraph report including a title and three facts based on collected data about objects, people or events.

- sentence frames
- a word bank
(e.g. vocabulary,
transition words)
- complete
collaboratively



Student could complete a visual
representation of understandings
(includes labels).

Wrap-up

The science investigations and engineering challenges allow students to gain and demonstration science understandings and language acquisition in multiple ways.

Self-Reflection:

- What are two strategies am I taking away today that I can implement in my instruction tomorrow?
- How am I going to support my ELLs so that they can successfully access the STEM disciplines?

Contact Us

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